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The Mineral Industry of Norway

UNITED STATES DEPARTMENT OF THE INTERIOR

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The Mineral Industry of Norway

By Richard H. Singleton[1]

Norwegian aluminum and zinc production reached record highs during 1987 after 2 years of contraction. Expansion of the country's only nickel refinery was completed during the year. Two of six pig iron furnaces were closed, and coke production decreased, as the steel industry became more dependent on scrap as raw material. The state-owned steel industry continued to operate at a loss, and rationalizations were being planned to return to profitable operation. One silicon plant was closed and production at another was halved in response to world overcapacity and to low world prices and demand, especially in Western Europe. Imports of manganese ore from the Republic of South Africa for Norway's large ferroalloys industry were excluded for at least 2 years from Norway's trade sanctions against the Republic of South Africa. A new gallium recovery plant for production of gallium for export became operational. Scandium exploration and deposit evaluation began and a pilot plant for production of high-purity oxide went onstream. A copper-zinc mine closed because of reserves depletion, a Government-subsidized iron mine closed because of lean ores, and a loss-producing zinc mine closed. A new shipping terminal, completed in 1986 for export of iron ore, was closed because of an underwater landslide.

Construction began on a graphite-flake concentrator to replace Norway's sole graphite plant that had been destroyed by fire in 1985. Technical problems delayed startup of a new high-purity quartz plant. Equipment problems prevented the new TiO_2-slag plant from reaching more than 20% of its capacity, and the plant was closed near yearend.

Production of crude oil and natural gas, all from the Norwegian sector of the North Sea, reached record highs in 1987 even though the Government continued to limit oil production at 8% below capacity in response to world production restraints called for by the Organization of Petroleum Exporting Countries (OPEC). Norway was not a member of OPEC. Proven reserves of crude oil, which decreased for the first time, were estimated to be sufficient for 17 years of production at the current production rate. Other estimated resources were sufficient to permit current annual production until about the year 2020. New estimates of gas reserves in the Frigg area, which accounted for 43% of Norway's gas production in 1987, indicated that this source would be depleted by yearend 1990. All of the Frigg area gas was exported to the United Kingdom. However, reserves of offshore gas appeared to be sufficient for about 80 years at 1987 production rates. Development of the Gullfaks and Oseberg Oilfields continued. In a major engineering feat, five platforms of the Ekofisk oil production complex were elevated simultaneously in August to prevent submergence of critical operations as a result of seabed subsidence.

Two oilfields and one gasfield received development approval from the Government. Gas from the Tommelitin Gasfield was to be injected into the Ekofisk Oilfield beginning in 1988 in order to boost production. Engineering design was begun for the platforms of the very large Sleipner and Troll Gasfields mainly to supply gas to the Western European mainland. Development plans for five new oilfields in the North Sea and in the Norwegian Sea were submitted by industry for Government approval. The Government presented a report for Parliamentary approval that would define policy

for limiting and prioritizing offshore oil and gas development. Developments in the Norwegian Sea including the Haltenbanken area were expected to be more costly than in the North Sea and especially dependent on attainment of a market for the gas coproduct. Exploration for petroleum in offshore Norway continued at the same level as in 1986 and included the North Sea, the Norwegian Sea, and the Barents Sea off the northern Arctic coast. Five wildcat wells drilled in the Barents Sea produced only one small gas find.

The minerals industry was estimated to account for approximately 15% of Norway's 1987 gross domestic product (GDP). A breakdown by value of the $12 billion[2] minerals industry in 1987 is primary fuels, 74%; primary metals, 24%; and industrial minerals, 2%. Approximately 90% of the total products of these industries was exported, mostly to Western Europe. The United States received about 5% of Norwegian mineral exports, mainly as crude petroleum, steel, and nickel, in order of value. Crude oil accounted for approximately 70% of the value of mineral fuels production; natural gas accounted for the balance, except for a small amount, 0.4%, of mined coal. A breakdown by value of the $2.9 billion metals-mining and -smelting industry was primary aluminum, 40%, ferroalloys, 20%; primary steel, 15%; and magnesium and nickel, about 6% each. Approximately two-thirds of the value of industrial minerals was accounted for by the cement, olivine, and ammonia industries, in order of value.

The national economy weakened somewhat and the real GDP increased by only 1%. Falling tax revenues from the North Sea petroleum industry, which continued to be plagued by declining product prices, and a generally weak onshore economy, including the nonfuel mineral industries, contributed to the malaise. However, the real value of exported goods increased by 8%, whereas the value of imported goods stabilized. Although private consumption fell, inflation increased to 9%. Wages increased by 12% and unemployment rose slightly to 2.1%. Total investment decreased slightly but remained high, 27% of the GDP, although it dropped by 9% in the offshore petroleum industry. Net foreign debt, already high, increased to 17% of the GDP. The unadjusted 1987 GDP was $83 billion. The Government continued its attempts to hold down inflation by limiting interest rates and attempting to contain wage increases.

PRODUCTION

Production of primary aluminum, nickel, and zinc each increased significantly. Expansions in aluminum- and zinc-smelting capacities had been completed in 1986. Decreases in iron ore and zinc concentrate production were caused by mine closures. Closures of pig iron furnaces caused reduced production of pig iron and coke. Production of primary copper decreased.

Production increases for ammonia and nepheline syenite were accompanied by decreased olivine production.

Production of North Sea crude oil increased significantly and natural gas production increased somewhat less. Production of oil refinery products increased in response to domestic demand.

Table 1.—Norway: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986	1987[p]
METALS					
Aluminum:					
Primary	713,014	765,083	742,686	725,813	806,092
Secondary	4,558	5,587	6,004	[e]6,000	[e]6,000
Cadmium, smelter	117	150	159	154	147
Cobalt	879	1,191	1,637	1,574	1,576
Copper:					
Mine output, Cu content	22,568	25,042	[r]18,969	21,887	21,984
Metal, primary plus secondary:					
Smelter	25,658	36,821	37,828	35,202	29,701
Refined	22,705	30,323	31,074	30,457	29,386

See footnotes at end of table.

Table 1.—Norway: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986	1987[p]
METALS —Continued					
Iron and steel:					
Ore and concentrate:					
Gross weight thousand tons	3,545	3,237	3,497	3,618	3,140
Fe content do.	2,307	2,500	2,321	2,377	e2,060
Metal:					
Pig iron do.	565	546	596	560	365
Ferroalloys:					
Ferrochromium[e]	4,000	--	--	--	--
Ferromanganese	283,492	285,169	267,670	195,257	191,992
Ferrosilicochromium[e]	400	--	--	--	--
Ferrosilicomanganese	194,784	280,953	256,457	223,490	237,277
Ferrosilicon (75% basis)	368,817	437,164	397,776	335,041	336,168
Other[e]	4,630	--	--	--	--
Total	856,123	1,003,286	921,903	753,788	765,437
Steel, crude thousand tons	895	920	958	836	837
Semimanufactures, rolled do.	561	615	664	687	e700
Lead, mine ouput, Pb content	4,309	3,967	3,597	3,366	e3,000
Magnesium, primary	29,844	49,301	54,704	56,864	56,907
Nickel:					
Mine output, Ni content	360	325	425	438	496
Metal, primary	28,619	35,548	37,513	38,202	44,565
Platinum-group metals[3] troy ounces	40,832	44,529	44,079	51,440	e50,000
Silicon metal	76,85e	89,398	105,552	e100,000	e90,000
Zinc:					
Mine output, Zn content	32,356	28,513	27,352	27,508	22,164
Metal, primary	90,668	94,248	92,762	90,475	116,468
INDUSTRIAL MINERALS					
Cement, hydraulic thousand tons	1,666	1,547	1,343	1,625	1,639
Feldspar	57,960	67,820	80,095	87,257	e90,000
Gallium[e] kilograms	--	--	--	--	1,000
Gold[e] troy ounces	--	--	300	3,000	30,000
Graphite	8,063	10,067	2,684	--	--
Lime, hydrated and quicklime[e] thousand tons	130	130	100	100	100
Mica, flake[e]	4,000	4,000	4,000	3,000	3,000
Nepheline syenite thousand tons	220	226	227	218	242
Nitrogen: N content of ammonia do.	513	636	458	300	347
Olivine sand do.	1,354	1,772	1,989	2,537	1,912
Pyrite do.	357	428	395	380	358
Stone, crushed:					
Dolomite do.	422	534	555	e550	e550
Limestone do.	4,303	3,995	3,827	e4,000	e4,000
Quartz and quartzite do.	582	828	775	e800	e800
Sulfur:					
Pyrite, S content do.	r220	203	193	181	e180
Byproduct of:					
Metallurgy do.	r e54	62	60	67	e85
Petroleum do.	8	8	10	e13	e10
Total do.	282	273	263	261	e275
Talc, soapstone, steatite[e] do.	100	r113	100	100	100
Titania:					
Ilmenite concentrate do.	556	652	736	802	852
TiO_2 content do.	247	289	327	357	378
MINERAL FUELS AND RELATED MATERIALS					
Coal, all grades thousand tons	502	451	507	437	448
Coke, all grades do.	314	337	r313	313	284
Gas:					
Manufactured million cubic feet	171	73	--	--	--
Natural:					
Gross billion cubic feet	e1,000	1,144	1,202	1,119	1,216
Marketable[4] do.	932	964	983	973	1,076
Marketed[5] do.	912	944	898	829	998
Peat:[e]					
For agriculture thousand tons	30	30	30	30	30
For fuel do.	1	1	1	1	1

See footnotes at end of table.

Table 1.—Norway: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity		1983	1984	1985	1986	1987[p]
MINERAL FUELS AND RELATED MATERIALS —Continued						
Petroleum:						
Crude[6]	thousand 42 gallon barrels	217,900	251,500	[r]276,700	295,700	344,000
Natural gas liquids	do.	15,590	14,730	[r]16,440	21,720	22,470
Refinery products:						
Naphtha	do.	4,311	3,429	[r]3,834	3,618	4,419
Gasoline	do.	10,124	11,849	[r]11,466	10,548	12,248
Kerosene	do.	4,526	4,687	[r]5,906	5,549	6,402
Distillate fuel oil	do.	25,110	24,767	[r]26,811	27,199	33,756
Residual fuel oil	do.	5,641	6,693	[r]4,942	5,934	6,973
Other	do.	3,568	3,972	[r]3,997	3,380	4,050
Refinery fuel and losses	do.	3,074	3,642	[r]4,277	3,823	3,795
Total	do.	56,374	59,039	[r]61,133	60,051	71,643

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available Sept. 15, 1988.

[2]Data represent exports, part of which may be derived from imported materials.

[3]Reported figure.

[4]Gross less gas reinjected and flared.

[5]Marketable less gas used as fuel during production for 1983. Reported as total methane sales after 1983.

[6]Excluding natural gas liquids. The crude oil entry in the 1985 Norway chapter included natural gas liquids content.

TRADE

Primary mineral products were approximately 50% of the value of Norway's exported goods in 1987. Of this, about 75% was North Sea crude petroleum and natural gas and most of the balance was metal products, valued at the primary metal stage or earlier in the production sequence. Essentially all of the natural gas and about 85% of crude oil production were exported. Natural gas made up 32% of the value of the petroleum export component, compared with 47% in 1986. The main cause of this decrease was a 35% drop in the average 1987 price of gas and only a 10% increase in the price of crude oil. These changes were accompanied by an 18% increase in the volume of oil exports and an 8% increase in the volume of gas exports. Primary aluminum was about 40% of the total value of exported metals.

Export of goods to the United States increased in real value by 15% to a current value of about $1.5 billion. Of this, 9% was crude oil, about 27 million barrels. U.S. export of goods to Norway decreased in real value by 18% to a current value of $0.8 billion.

Table 2.—Norway: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate		60	--	All to Sweden.
Oxides and hydroxides	915	12,642	--	United Kingdom 10,102; Netherlands 1,506; Sweden 1,002.
Metal including alloys:				
Scrap	28,725	31,126	--	West Germany 11,613; Sweden 7,952; Finland 3,984.
Unwrought	643,790	646,539	4,209	West Germany 195,054; United Kingdom 119,549; Netherlands 105,813.
Semimanufactures	82,445	85,833	5,004	United Kingdom 19,227; Sweden 10,066; France 8,755.

See footnote at end of table.

Table 2.—Norway: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS —Continued				
Beryllium: Metal including alloys, all forms	3	—		
Chromium: Oxides and hydroxides	5	—		
Cobalt: Oxides and hydroxides	—	(2)	—	All to Malaysia.
Copper:				
Ore and concentrate	92,851	106,237	—	West Germany 49,602; Finland 42,491; Sweden 14,144.
Metal including alloys:				
Scrap	5,257	7,316	—	West Germany 3,964; Italy 838; Sweden 816.
Unwrought	34,308	34,558	509	West Germany 11,190; United Kingdom 9,598; Sweden 5,059.
Semimanufactures	3,859	2,640	19	Sweden 841; United Kingdom 508; West Germany 394.
Iron and steel:				
Iron ore and concentrate:				
Excluding roasted pyrite thousand tons	2,578	2,532	—	West Germany 1,010; United Kingdom 790; France 346.
Pyrite, roasted do	107	8	(2)	Denmark 2; Sweden 2; West Germany 1.
Metal:				
Scrap	9,801	7,704	3	Sweden 2,201; Denmark 1,991; West Germany 1,336.
Pig iron, cast iron, related materials	32,201	22,898	—	United Kingdom 16,105; Sweden 4,115; Denmark 1,247.
Ferroalloys:				
Ferromanganese	180,018	162,175	5,309	West Germany 24,297; United Kingdom 23,213; Sweden 22,909.
Unspecified	607,846	553,316	49,018	West Germany 153,057; Japan 78,636; United Kingdom 64,455.
Steel, primary forms	143,803	41,353	—	Netherlands 27,175; United Kingdom 9,976; Sweden 2,525.
Semimanufactures:				
Bars, rods, angles, shapes, sections	354,015	239,127	49,434	West Germany 61,957; Italy 34,505.
Universals, plates, sheets	173,210	150,097	11,792	Sweden 35,459; United Kingdom 32,344; Denmark 26,829.
Hoop and strip	13,971	16,350	—	Sweden 14,442; Denmark 1,490; West Germany 146.
Rails and accessories	879	2,223	(2)	West Germany 1,000; United Kingdom 498; Netherlands 412.
Wire	8,683	9,798	1,646	United Kingdom 1,226; West Germany 1,172.
Tubes, pipes, fittings	65,641	56,428	5,288	Sweden 27,896; Denmark 5,872.
Castings and forgings, rough	4,602	3,198	1	Sweden 2,852; Denmark 252; United Kingdom 43.
Lead:				
Ore and concentrate	6,686	7,180	—	All from West Germany.
Oxides	3	16	—	Malaysia 6; Turkey 6; Denmark 2.
Metal including alloys:				
Scrap	6,475	7,171	—	Sweden 6,571; West Germany 234; Netherlands 181.
Unwrought	44	28	—	Sweden 26; Austria 2.
Semimanufactures	1	1	—	All to Gambia.
Magnesium: Metal including alloys:				
Scrap	22	103	—	West Germany 102; Sweden 1.
Unwrought value, thousands	$136,476	$146,530	NA	NA.
Semimanufactures	30	164	98	West Germany 36; Sweden 27.
Manganese: Ore and concentrate, metallurgical-grade	—	505	—	All to Sweden.
Mercury 76-pound flasks	1,653	870	—	Spain 841.
Molybdenum: Metal including alloys, all forms	1	1	—	NA.

See footnotes at end of table.

Table 2.—Norway: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS —Continued				
Nickel:				
Ore and concentrate	10,843	11,871	--	Finland 11,848; West Germany 23.
Metal including alloys:				
Scrap	143	108	65	West Germany 20; United Kingdom 14.
Unwrought	35,666	37,917	16,821	Netherlands 5,591; West Germany 3,922.
Semimanufactures	17	30	--	Netherlands 11; Finland 7; Denmark 4.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$11,622	$16,260	$107	West Germany $11,273; Sweden $3,769; United Kingdom $605.
Silver:				
Waste and sweepings[3] do.	$1,949	$2,761	--	West Germany $2,399; United Kingdom $342; Sweden $9.
Metal including alloys, unwrought and partly wrought do.	$4,969	$6,141	$15	Sweden $2,734; Denmark $1,016; Canada $842.
Tin: Metal including alloys:				
Scrap	21	12	--	Belgium-Luxembourg 5; Sweden 3; United Kingdom 3.
Unwrought	9	5	--	Sweden 4; United Kingdom 1.
Semimanufactures	13	23	--	West Germany 21; Singapore 1.
Titanium: Oxides	3,245	1,253	--	Sweden 958; Denmark 197; Finland 21.
Tungsten: Metal including alloys, all forms	3	(4)	--	Mainly to Sweden.
Zinc:				
Ore and concentrate	10,959	8,355	--	All to West Germany.
Oxides	3,133	3,004	--	United Kingdom 1,852; West Germany 502; Sweden 261.
Metals including alloys:				
Scrap	308	539	--	Sweden 251; United Kingdom 201; West Germany 47.
Unwrought	78,639	77,235	11,941	Sweden 18,110; West Germany 16,363; United Kingdom 14,075.
Semimanufactures	6,547	6,636	--	West Germany 1,138; Netherlands 879; Denmark 651.
Other:				
Ores and concentrates	641,910	693,265	--	West Germany 250,537; Finland 164,111; United Kingdom 96,984.
Ashes and residues value, thousands	$53,521	$38,901	$476	Republic of South Africa $33,382; Canada $1,555; Belgium-Luxembourg $1,493.
Base metals including alloys, all forms	1,681	1,859	883	Netherlands 405; Japan 173.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc	70	22	--	Iceland 20; Sweden 1.
Artifical: Corundum	10	4	--	West Germany 1; Netherlands 1; Sweden 1.
Dust and powder of precious and semiprecious stones including diamond value, thousands	--	$4	--	All to Sweden.
Grinding and polishing wheels and stones	878	690	60	Finland 153; Sweden 148.
Asbestos, crude	--	1	--	All to Netherlands.
Barite and witherite	8,801	10,053	--	Denmark 6,854; United Kingdom 3,001; Sweden 141.
Boron materials: Oxides and acids	7	--		
Cement	35,632	653	NA	NA.
Chalk	--	3	--	Algeria 1.
Clays, crude	437	103	--	Denmark 72; Sweden 14; United Kingdom 13.
Cryolite and chiolite	2	2	--	All to Sweden.
Diamond:				
Gem, not set or strung value, thousands	$546	$108	--	Belgium-Luxembourg $45; West Germany $33; Switzerland $10.
Industrial stones do.	--	$13	--	All to Finland.

See footnotes at end of table.

Table 2.—Norway: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS —Continued				
Diatomite and other infusorial earth: value, thousands	$2	$6	--	All to West Germany.
Feldspar, fluorspar, related materials	316,662	302,847	--	Netherlands 88,067; United Kingdom 63,679; West Germany 59,370.
Fertilizer materials:				
Crude, n.e.s	6	1	--	All to West Germany.
Manufactured:				
Ammonia: value, thousands	$4,619	$1,608	NA	NA.
Nitrogenous: do	$87,194	$81,677	NA	NA.
Potassic: do	--	$3	--	All to West Germany.
Unspecified and mixed: do	$148,906	$155,247	NA	NA.
Graphite, natural	6,161	954	NA	NA.
Gypsum and plaster	36	29	--	Sweden 17; Denmark 12.
Lime	822	4,860	--	Liberia 3,500; Denmark 1,124; Sweden 201.
Magnesium compounds	10,271	8,689	NA	NA.
Mica:				
Crude including splittings and waste	1,934	1,422	--	Netherlands 416; West Germany 320; Sweden 140.
Worked including agglomerated splittings	(2)	(2)	--	NA.
Phosphates, crude	51	--	--	--
Pigments, mineral: Iron oxides and hydroxides, processed	18	44	19	Thailand 11; Singapore 8.
Precious and semiprecious stones other than diamond:				
Natural: value, thousands	$160	$40	--	Denmark $23; Hong Kong $6; Belgium-Luxembourg $4.
Synthetic: do	$4[3]	$4	--	All to Denmark.
Pyrite, unroasted	169,308	172,650	--	Italy 69,856; West Germany 62,971; Sweden 38,384.
Salt and brine: value, thousands	$167	$237	--	West Germany $108; Sweden $97; Denmark $23.
Sodium compounds, n.e.s.: Carbonate, manufactured	11	23	--	United Kingdom 22.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked: thousand tons	212	270	1	Netherlands 119; West Germany 42; France 29.
Worked: do	12	12	(2)	Netherlands 9; Sweden 1.
Dolomite, chiefly refractory-grade: do	168	168	NA	NA.
Gravel and crushed rock: do	3,490	4,120	192	West Germany 1,629; Netherlands 531; Denmark 465.
Limestone other than dimension: do	9	4	--	Mainly to United Kingdom.
Quartz and quartzite: do	93	124	--	Iceland 111; Denmark 9; United Kingdom 2.
Sand other than metal-bearing: value, thousands	$386	$376	$25	United Arab Emirates $161; West Germany $83; Japan $63.
Sulfur:				
Elemental:				
Crude including native and by-product	3,722	2,643	--	United Kingdom 1,812; France 793; Sweden 34.
Colloidal, precipated, sublimed	1,317	2,751	--	Sweden 1,869; United Kingdom 882.
Sulfuric acid: value, thousands	$7,045	$8,283	NA	NA.
Talc, steatite, soapstone, pyrophyllite	44,435	42,702	--	United Kingdom 10,486; Netherlands 9,124; West Germany 7,915.
Other:				
Crude	68	788	--	Sweden 442; Netherlands 203; Denmark 70.
Slag and dross, not metal-bearing	6,508	17,698	76	Denmark 12,740; Sweden 4,502; Singapore 156.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	6	1,565	--	Sweden 1,384; Iceland 169; United Kingdom 9.
Carbon black	37	6	--	Sweden 4; Denmark 1; Malaysia 1.
Coke and semicoke	122,270	124,984	--	Netherlands 37,266; Sweden 27,564; Iceland 22,450.

See footnotes at end of table.

Table 2.—Norway: Exports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS —Continued				
Gas, natural: Gaseous[4] million cubic feet	898,012	905,923	--	West Germany 454,180; United Kingdom 451,743.
Peat including briquets and litter	33	385	--	All to United Kingdom.
Petroleum:				
Crude thousand 42-gallon barrels	240,790	264,366	13,009	United Kingdom 148,962; Netherlands 34,781; Sweden 21,906.
Refinery products:				
Liquefied petroleum gas[4] do.	1,636	1,578	174	Denmark 406; Netherlands 325.
Gasoline do.	5,463	5,302	153	Sweden 2,089; United Kingdom 1,712; Netherlands 350.
Mineral jelly and wax do.	2	(2)	--	Mainly to Sweden.
Kerosene and jet fuel do.	1,667	1,634	--	Denmark 526; Netherlands 231; United Kingdom 228.
Distillate fuel oil do.	5,171	5,230	--	Denmark 3,054; West Germany 1,091; Sweden 310.
Lubricants do.	40	47	(3)	Sweden 22; Netherlands 17; Denmark 4.
Residual fuel oil do.	7,631	6,318	984	France 1,095; West Germany 1,068.
Bitumen and other residues do.	1	24	--	Sweden 23; Spain 1.
Bituminous mixtures do.	(2)	4	--	Mainly to United Kingdom.
Petroleum coke do.	464	446	--	Netherlands 354; United Kingdom 54; Yugoslavia 19.

NA Not available.
[1]Table prepared by Jozef Plachy.
[2]Less than 1/2 unit.
[3]May include other precious metals.
[4]International Energy Agency.

Table 3.—Norway: Imports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS				
Aluminum:				
Ore and concentrate	5,590	5,871	--	Greece 5,850; United Kingdom 21.
Oxides and hydroxides thousand tons	1,479	1,496	26	Suriname 469; Australia 451; Ireland 201.
Metal including alloys:				
Scrap	2,127	3,213	--	Denmark 2,119; Sweden 514; West Germany 362.
Unwrought	34,679	35,118	24	Brazil 10,194; U.S.S.R. 9,002; Sweden 3,494.
Semimanufactures	47,535	54,410	155	West Germany 24,965; Sweden 7,561; Belgium-Luxembourg 3,837.
Beryllium: Metal including alloys, all forms	--	(2)	(2)	Mainly from Sweden.
Chromium:				
Ore and concentrate	110	520	--	Greece 450; Finland 60; Netherlands 10.
Oxides and hydroxides	87	152	--	West Germany 110; China 20; Italy 10.
Cobalt: Oxides and hydroxides	9	1	--	All from Austria.
Columbium and tantalum: Metal including alloys, all forms, tantalum	(2)	(2)	--	Mainly from Sweden.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS —Continued				
Copper:				
Ore and concentrate	1,972	--		
Matte and speiss including cement copper	2,488	584	--	Zimbabwe 518; Sweden 46; Finland 21.
Metal including alloys:				
Scrap	526	56	1	Sweden 54; United Kingdom 1.
Unwrought	2,717	3,080	(2)	West Germany 1,575; United Kingdom 543; Sweden 516.
Semimanufactures	28,773	31,352	54	West Germany 8,653; Sweden 8,549; Belgium-Luxembourg 8,208.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite	230,175	17,715	--	All from Sweden.
Metal:				
Scrap	10,831	6,145	15	Denmark 2,355; Sweden 2,301; West Germany 1,117.
Pig iron, cast iron, related materials	8,671	7,432	1	Sweden 2,811; West Germany 1,112; United Kingdom 1,045.
Ferroalloys:				
Ferromanganese	(2)	--	--	
Unspecified	2,844	2,389	55	Sweden 992; West Germany 603; United Kingdom 526.
Steel, primary forms	142,511	131,162	1	Netherlands 53,474; West Germany 48,216; France 14,494.
Semimanufactures:				
Bars, rods, angles, shapes, sections	226,030	276,329	26	Sweden 61,282; West Germany 57,930; France 34,297.
Universals, plates, sheets	540,243	517,587	157	Sweden 110,732; West Germany 80,716; Belgium-Luxembourg 72,930.
Hoop and strip	36,515	36,148	4	West Germany 15,273; Sweden 8,919; Austria 3,098.
Rails and accessories	17,402	17,407	--	Sweden 12,528; West Germany 3,423; United Kingdom 884.
Wire	18,372	20,047	7	Belgium-Luxembourg 8,408; Sweden 6,395; France 1,653.
Tubes, pipes, fittings	192,656	200,530	801	West Germany 48,303; United Kingdom 34,668; France 23,942.
Castings and forgings, rough	3,634	5,429	19	Denmark 1,930; Sweden 1,591; Finland 693.
Lead:				
Oxides	412	175	1	West Germany 142; France 17; United Kingdom 15.
Metal including alloys:				
Scrap	104	--	--	
Unwrought	13,790	14,231	--	Sweden 11,199; United Kingdom 2,802; West Germany 117.
Semimanufactures	2,593	2,763	(2)	Belgium-Luxembourg 1,227; Netherlands 919; West Germany 506.
Magnesium: Metal including alloys:				
Scrap	22	--	--	
Unwrought	280	360	321	Sweden 26; Switzerland 12.
Semimanufactures	17	64	1	West Germany 33; Sweden 21; Netherlands 5.
Manganese:				
Ore and concentrate, metallurgical-grade	703,794	817,544	20,707	Republic of South Africa 332,423; Gabon 265,300; France 61,633.
Oxides	972	1,290	3	Netherlands 1,059; Belgium-Luxembourg 96; United Kingdom 92.
Mercury 76-pound flasks	377	87	--	West Germany 80; Sweden 4; Turkey 3.
Molybdenum: Metal including alloys, all forms	1	7	(2)	Spain 5.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
METALS —Continued				
Nickel:				
Matte and speiss	102,449	101,073	1,308	Canada 68,754; Republic of South Africa 29,014.
Metal including alloys:				
Scrap	3	12	--	All from United Kingdom.
Unwrought	189	154	33	United Kingdom 51; Canada 32.
Semimanufactures	250	292	18	West Germany 120; United Kingdom 104; Sweden 18.
Platinum-group metals: Metals including alloys, unwrought and partly wrought value, thousands	$4,980	$6,246	$247	West Germany $1,796; Switzerland $1,485; United Kingdom $1,272.
Silver:				
Waste and sweepings[3] do	$2,283	$4,525	--	Sweden $3,914; Turkey $230; Finland $196.
Metal including alloys, unwrought and partly wrought do	$9,634	$10,063	$9	Sweden $3,042; West Germany $2,695; United Kingdom $2,588.
Tin: Metal including alloys:				
Scrap	--	1	--	All from United Kingdom.
Unwrought	482	562	--	United Kingdom 303; Netherlands 87; Sweden 81.
Semimanufactures	153	185	(2)	West Germany 85; United Kingdom 56; Sweden 23.
Titanium, oxides	1,334	1,668	--	West Germany 1,371; Netherlands 224; Belgium-Luxembourg 50.
Tungsten: Metal including alloys, all forms	2	2	(2)	United Kingdom 1.
Zinc:				
Ore and concentrate	104,461	110,468	--	Sweden 69,036; Canada 24,725; Ireland 11,768.
Oxides	2,296	2,503	--	East Germany 1,914; West Germany 346; Sweden 167.
Metal including alloys:				
Scrap	5,551	5,900	--	Denmark 2,648; Finland 1,612; Sweden 1,529.
Unwrought	819	377	--	Finland 115; Sweden 99; Netherlands 90.
Semimanufactures	900	1,012	(2)	France 295; West Germany 282; Netherlands 238.
Other:				
Ores and concentrates	276	3,926	--	Sweden 3,828; Finland 24; Australia 22.
Ashes and residues	255,911	266,610	116	West Germany 197,197; West Germany 50,002; Sweden 18,019.
Base metals including alloys, all forms	2,289	1,835	331	Belgium-Luxembourg 501; Netherlands 211; Republic of South Africa 200.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural, corundum, emery, pumice, etc	10,807	12,420	53	Iceland 10,924; Greece 850; West Germany 278.
Artificial: Corundum	999	610	(2)	West Germany 447; Austria 77; France 44.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$7	$11	$10	NA.
Grinding and polishing wheels and stones	1,044	1,046	7	West Germany 300; Austria 247; Sweden 169.
Asbestos, crude	1	1	--	All from West Germany.
Barite and witherite	124,048	116,489	--	Morocco 96,489; Ireland 17,000; Spain 2,000.
Boron materials:				
Crude natural borates	16	25	25	
Oxides and acids	266	388	NA	NA.
Cement	243,326	559,886	49	Sweden 230,681; Ireland 105,280; Poland 79,351.
Chalk	8,352	8,044	12	Denmark 4,380; Sweden 2,648; France 686.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS —Continued				
Clays, crude	144,932	144,327	6,888	United Kingdom 86,538; Greece 17,269; Czechoslovakia 7,236.
Cryolite and chiolite	4,002	4,848	294	Denmark 2,792; Greenland 1,500; Netherlands 214.
Diamond:				
Gem, not set or strung, value, thousands	$2,008	$3,545	$69	Belgium-Luxembourg $2,187; United Kingdom $651; Switzerland $240.
Industrial stones, do	$28	$280	$2	Belgium-Luxembourg $265; Netherlands $9.
Diatomite and other infusorial earth	2,177	1,986	113	Iceland 1,076; Denmark 347; United Kingdom 132.
Feldspar, fluorspar, related materials	47,320	47,209	--	Morocco 18,858; Spain 18,531; East Germany 4,752.
Fertilizer materials:				
Crude, n.e.s.	38	1	--	All from West Germany.
Manufactured:				
Ammonia	114,816	231,409	16,909	U.S.S.R. 70,877; Trinidad and Tobago 58,452; Netherlands 35,995.
Nitrogenous	4,126	12,085	(2)	Netherlands 9,847; Sweden 1,757; Austria 209.
Phosphatic	2,838	2,568	--	Sweden 2,404; Netherlands 148; Belgium-Luxembourg 10.
Potassic	343,693	317,670	18	West Germany 76,345; Spain 66,565; France 55,029.
Unspecified and mixed	39,208	43,961	7	Belgium-Luxembourg 25,451; West Germany 11,736; Sweden 3,873.
Graphite, natural	495	8,211	--	Sweden 4,823; United Kingdom 2,964; West Germany 342.
Gypsum and plaster	209,567	211,318	--	Spain 116,474; France 43,298; East Germany 28,552.
Lime	41,071	35,750	(2)	Denmark 25,073; Sweden 7,494; United Kingdom 638.
Magnesium compounds	7,947	6,911	2	China 3,108; Austria 2,007; North Korea 551.
Mica:				
Crude including splittings and waste	4,044	1,284	57	India 1,087; Netherlands 102.
Worked including agglomerated splittings	63	63	(2)	Switzerland 37; United Kingdom 11; Belgium-Luxembourg 8.
Nitrates, crude	83	156	--	All from West Germany.
Phosphates, crude	452,112	445,807	25,584	Sweden 165,253; Togo 90,038; Morocco 81,487.
Pigments, mineral: Iron oxides and hydroxides, processed	2,726	2,450	--	West Germany 2,291; Spain 105; Netherlands 41.
Precious and semiprecious stones other than diamond:				
Natural, value, thousands	$2,870	$431	$14	West Germany $135; United Kingdom $81; Belgium-Luxembourg $38.
Synthetic, do	$270	$36	$4	Switzerland $10; West Germany $7; United Kingdom $5.
Pyrite, unroasted	--	3,948	--	All from Finland.
Salt and brine	561,314	555,609	4	Netherlands 336,363; United Kingdom 59,766; Spain 55,488.
Sodium compounds, n.e.s.: Carbonate, manufactured	49,982	48,869	--	Poland 15,454; Netherlands 14,440; West Germany 12,686.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	9,726	10,149	3	Sweden 4,168; Italy 2,098; Finland 1,175.
Worked	17,738	23,544	(2)	Portugal 13,540; Sweden 5,887; Italy 1,689.
Dolomite, chiefly refractory-grade	11,342	8,211	--	Sweden 4,823; United Kingdom 2,964; West Germany 342.
Gravel and crushed rock	109,711	63,225	11	Sweden 61,383; Italy 716; Denmark 686.
Limestone other than dimension	244,954	216,133	--	United Kingdom 189,256; Denmark 14,160; France 7,607.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Sources, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS —Continued				
Stone, sand and gravel —Continued				
Quartz and quartzite	655,831	589,369	(2)	Sweden 329,665; Spain 244,732; Canada 11,869.
Sand other than metal-bearing	242,166	209,636	398	Belgium-Luxembourg 129,601; Sweden 54,218; United Kingdom 4,045.
Sulfur:				
Elemental:				
Crude including native and by-product	4,117	6,138	--	Sweden 5 697; West Germany 380; Belgium-Luxembourg 60.
Colloidal, precipitated, sublimed	61	11	--	West Germany 10; United Kingdom 1.
Sulfuric acid	120	1,937	(2)	France 1,731; Denmark 103; Sweden 49.
Talc, steatite, soapstone, pyrophyllite	8,046	6,302	30	Finland 2,061; China 236; Austria 221.
Other:				
Crude	85,086	71,084	(2)	West Germany 46,172; East Germany 10,903; Sweden 7,277.
Slag and dross, not metal-bearing	160,363	164,431	--	Denmark 131,638; Sweden 21,362; Netherlands 9,022.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	234	58	58	
Carbon black	5,532	5,857	64	Sweden 3,134; Netherlands 1,115; United Kingdom 983.
Coal:				
Anthracite and bituminous	913,054	769,563	232,923	Australia 88,715; West Germany 78,623.
Briquets of anthracite and bituminous coal	730	2,000	--	Belgium-Luxembourg 1,050; Netherlands 950.
Lignite including briquets	3,639	11	--	All from West Germany.
Coke and semicoke	700,176	600,709	23,150	United Kingdom 297,352; France 75,705; East Germany 54,621.
Peat including briquets and litter	17,949	20,710	--	Sweden 18,667; West Germany 1,355; Finland 577.
Petroleum:				
Crude thousand 42-gallon barrels	11,000	14,794	--	United Kingdom 11,061; Saudi Arabia 1,945; U.S.S.R. 1,457.
Refinery products:				
Liquefied petroleum gas[4] do	1,612	2,726	--	United Kingdom 2,459; U.S.S.R. 151.
Gasoline do	4,820	6,678	27	Sweden 2,742; Netherlands 1,927; United Kingdom 701.
Mineral jelly and wax do	77	73	(2)	West Germany 50; China 9; United Kingdom 9.
Kerosene and jet fuel do	1,031	2,345	26	United Kingdom 810; Netherlands 502; Libya 356.
Distillate fuel oil do	6,037	8,600	109	East Germany 2,218; Sweden 1,971; United Kingdom 1,205.
Lubricants do	746	683	10	Sweden 303; United Kingdom 202; Belgium-Luxembourg 58.
Residual fuel oil do	4,816	5,356	--	East Germany 1,661; U.S.S.R. 1,382; Sweden 1,362.
Bitumen and other residues do	1,197	1,323	(2)	Sweden 853; Netherlands 280; Belgium-Luxembourg 82.
Bituminous mixtures do	111	132	1	Sweden 101; Netherlands 24; Denmark 2.
Petroleum coke do	2,100	2,007	1,647	United Kingdom 192; Netherlands 115.

NA Not available.
[1]Table prepared by Jozef Plachy.
[2]Less than 1/2 unit.
[3]May include other precious metals.
[4]International Energy Agency.

COMMODITY REVIEW

METALS

Aluminum.—Hydro Aluminium A/S, the largest producer of primary aluminum in Western Europe, increased its share in Sör-Norge Aluminium A/S (Soral) to 50% by purchasing shares from the other owner, Swiss Aluminium Ltd. (Alusuisse). Soral operated a 66,000-ton-per-year primary aluminum plant at Husnes in Norway. Hydro's total annual primary aluminum capacity in Norway was 620,000 tons. A little over 600,000 tons was produced in 1987, a 10% increase. The company was 70%-owned by Norsk Hydro A/S, which had an option to buy the Government's 30% share. Hoyanger Verk, the smallest of Hydro's four 100%-owned aluminum smelters, operated at a loss, but the other three were profitable.

Mosal Aluminium A/S, 55%-owned by Elkem A/S and 45%-owned by the Aluminum Co. of America, produced 164,000 tons of primary aluminum at its two Norwegian smelters. The Lista smelter, one of the two, produced a record high 80,000 tons.

Copper.—The Lokken Gruber A/S copper-zinc mine southwest of Trondheim was closed at midyear because of reserves depletion after having been operational for more than 3 centuries. The mine, jointly owned by Orkla-Borregard A/S and Finland's Outokumpu Oy, was one of Norway's four largest copper mines that together had produced about 90% of Norway's copper concentrate. A fifth mine, Outokumpu's Bidjovagge Gruber A/S, had been reopened in 1985 after having been idle for 10 years. It was meant to supply concentrate to Outokumpu's Harjavalta smelter in Finland. Production from this mine reached 3,200 tons of copper in concentrate during 1987. One lead-zinc mine and an iron mine each produced minor amounts of byproduct copper concentrate. A/S Sydvaranger closed its small A/S Killingdal Grubeselskab copper-zinc mine and flotation plant at Trondheim early in the year.

In May, Orkla-Borregard and Outokumpu formed a joint venture, Norsulfid A/S, which owned and operated Folldal Verk A/S and 51% of Grong Gruber A/S, two of the three largest remaining copper mines. Both produced byproduct zinc concentrate. Folldal Verk was also a major producer of pyrite. It was intended to transfer Orkla-Borregard's shares to Outokumpu by year-end 1988, at which time Orkla-Borregard would no longer be in mining.

Ferroalloys.—The Norwegian ferroalloy industry maintained its production level and West European market position despite world market low prices and increased production from developing countries, particularly Brazil. Ferroalloy price recoveries during the second half came too late to prevent industry from suffering a significant financial loss during 1987. Dumping was alleged of producers other than Norway of ferrosilicon into the European Economic Community (EEC) market at prices 10% below those prevailing.

Manganese ore was excluded for at least 2 years from sanctions legislated by the Norwegian Government effective July 20 against trade with the Republic of South Africa. Approximately 40% of ferroalloy industry needs for this ore had been supplied by this source, mostly for use at the Porsgrunn and Sauda ferromanganese smelters. About one-third of manganese ore imports was from Gabon, where the Norwegian ferroalloy industry owned part of the manganese-mining industry.

Gallium.—Elkem began preliminary operation of Norway's first gallium metal recovery plant. The $2 million plant, with a capacity of 5,000 kilograms per year, was constructed on the site of Elkem's Bremanger ferrosilicon smelter. Nearly all of the 99.99%-pure metal was scheduled for export primarily for manufacture of gallium arsenide for use in semiconductors.

Gold.—Significant quantities of gold were found by Outokumpu in its recently reopened Biddjovagge copper mine in northern Norway. Subsequently, only those seams were mined that were rich in gold, 1 to 4 grams per ton, as well as rich in copper, 1% to 2%. Concentration of the ore produced about 30,000 troy ounces of gold and 3,200 tons of copper during 1987. The concentrate was shipped by truck and rail to Outokumpu's Harjavalta smelter in Finland. The former byproduct gold had become significantly more valuable than the copper in the Biddjovagge Mine. Reserves were sufficient for only 1 or 2 years of operation. No significant amounts of gold had been mined in Norway during the previous few decades.

Iron Ore.—State-owned A/S Sydvaranger ceased mining its Tverrdalen deposit be-

cause the deposit contained the leanest ores and had the highest production costs of any of its iron mines. The company continued to operate at a loss, requiring an annual Government subsidy of about $30 million. Three iron ore deposits were being mined at yearend. These were Bjornevatn North, Bjornevatn East, and Jerntoppen, which was opened in 1987. Total production of iron ore concentrate by Sydvaranger decreased by 20% to 1.45 million tons. Nearly 50% of the concentrate came from Bjornevatn North. The concentrate was pelletized, and more than 95% of the high-silica (acid) pellets was shipped overseas, primarily to the United Kingdom, 74%, and to the Federal Republic of Germany, 25%.

State-owned Norsk Jernverk A/S, the other large iron ore producer, decreased its production rate in August by 35% to 1.0 million tons of iron ore per year because of low product prices. Employees in the Mining Division in the Mo i Rana area were reduced by 20% to 325. Total concentrate production decreased by 10% to 1.29 million tons. Of this, 41% was consumed by the company in its production of pig iron, compared with 61% in 1986. The balance was exported. An underwater landslide in February closed the company's new shipping terminal on the west coast, requiring alternative shipping arrangements. Norsk Jernverk, Norway's only primary steel producer, received no Government subsidies during 1987, although it operated at a loss. Continuance of the company's mining activity, which was only about 10% of the company's total activity, remained in doubt as talks with the Government continued regarding its mining future.

Iron and Steel.—Norsk Jernverk closed two of its six pig iron furnaces at its Mo i Rana complex, thereby reducing Norway's iron production capacity by one-third. The company's two LD steel oxygen converters at the complex then used more scrap iron feed to compensate for the lost pig iron. A newly commissioned steel arc furnace at the complex reached full capacity by yearend. Approximately 80% of the company's crude steel was made at Mo i Rana and about 80% of that was used as feedstock for its rolling mills. The remainder of the crude steel was made in an arc furnace at the Nydalen works at Oslo. About 60% of Norsk Jernverk's rolling capacity was at Mo i Rana, 25% was at Nydalen, and the remainder was at a tinplate plant at Bergen. The company concentrated during the year on markets in the Nordic area, the EEC and the United States. The offshore oil market for steel was down although the market for reinforcing steel bars remained steady. Productivity was up on a ton-per-wage-krona basis. However, a consulting firm was contracted to present rationalization options to enable the company to return to a position of profit. Construction was completed of a pilot plant for development of a new steelmaking (direct reduction) process in partnership with Elkem.

Lead.—A/S Bleikvassli Gruber's zinc-lead mine remained the only lead concentrate producer in Norway after closure at midyear of the Bergverkselskapet Nord-Norge A/S zinc mine, which had produced minor amounts of byproduct lead. Both companies were subsidiaries of Sydvaranger.

Magnesium.—Construction of Norsk Hydro's 60,000-ton-per-year magnesium plant in Becancour, Quebec, Canada, began in the spring. Startup was still scheduled for spring 1989 and full capacity was expected to be reached by 1990 or 1991. The major end user was expected to be the U.S. automotive industry, but a substantial portion was targeted for the overseas market, particularly Japan.

Nickel.—A major expansion at Falconbridge Nikkelverk's A/S refinery at Kristiansand was completed during the year. Capacity was increased by 33% in order to process annually 54,400 tons of nickel matte delivered under a long-term contract with BCL Ltd. of Botswana. Production of electrolytic nickel during 1987 increased by 17% to a record high despite a 1-month scheduled production shutdown caused by low prices and a world oversupply.

Scandium.—Elkem, along with Mitsubishi Corp. of Japan, assumed controlling interest in A/S Megon, a producer of yttrium oxide for use in laser crystals and other "high-tech" applications at a plant near Oslo. Megon was engaged in the development of technologies for extracting and purifying rare-earth oxides including scandium oxide, a valuable material used in superconductors, collimators for neutron lenses, high-powered lights, and semiconductors. A pilot plant was reported to have become operational during 1987 producing 99.999%-purity scandium oxide. Eventual capacity of the plant was to be 10 kilograms per year. Elkem was exploring in Norway for scandium-bearing deposits.

Folldal Verk A/S acquired mining rights

to a large, unique rock deposit in the Kautokeno greenstone belt in Finnmark in Arctic Norway. It contained mostly albite, but also the rare titanium mineral davidite, which contained inclusions of thortveitite, which in turn contained scandium. Further evaluation of the deposit, estimated to contain up to 5,000 kilograms of scandium, was underway. The deposit had been first discovered in 1983 by the Norwegian Geological Survey using airborne geophysical methods.

Vesteralen Mining Industries, a new venture company, announced plans to mine a scandium-bearing titaniferous magnetite deposit in the Vesteralen region of Arctic Norway. Plant construction was to begin in mid-1988 with production startup in mid-1989. The deposit appeared to be much larger than the more northerly Finnmark deposit. Prefeasibility studies were in progress and financing through sale of stock and/or mining partners was being sought.

Silicon.—Oversupply of silicon in the world market, caused mainly by increased production capacity in Brazil and the emergence into the world market of inexpensive low grades from China, caused Tinfoss Jernverk A/S to close permanently its only silicon plant, at Notodden, at the beginning of the year. This oversupply also caused Elkem to close one-half of its 33,000-ton-per-year Meraker plant in the fall and to reduce staff accordingly. Norway's major markets, Western Europe and Japan, were very depressed during the first half of the year. They did not fully recover during the second half despite increases in aluminum production, the major end use of silicon. Specialty grades for the electronics industry were produced at Elkem's Bremanger plant, mainly for Japan. Total Norwegian annual capacity at yearend was about 100,000 tons. Operating problems halted production at some plants for short periods. Elkem's United States and Canadian silicon operations stepped up in response to increased aluminum production in North America. The North America silicon plants had been rationalized extensively over the previous few years.

Zinc.—One zinc mine, Sydvaranger's Bergverkselskapet Nord-Norge, and the Lokken Gruber Mine with copper and zinc coproducts closed as scheduled at midyear. The closings lowered Norway's zinc-mining capacity by about 7,000 tons per year of zinc in concentrate and decreased 1987 production by 19%. Two zinc mines and a copper mine with zinc byproduct remained with a combined annual capacity of a little under 20,000 tons of zinc in concentrate.

Norzink A/S produced 29% more zinc metal, all at its Eitrheim smelter, although production was 7% below the targeted output because of startup problems in the new cellhouse as well as foundry difficulties. The smelter complex operated at a loss because of high production costs and low product prices, which began to increase during the final quarter.

INDUSTRIAL MINERALS

Fertilizer Materials.—Norsk Hydro put its new complex-fertilizer plant on-stream at Porsgrunn during the year. Some temporary stoppages were incurred subsequently by operational failures. A new calcium nitrate plant also came on-stream at Porsgrunn.

Norsk Hydro, the world's largest fertilizer producer, purchased the remaining 20% of Cie. Française de l'Azote et Produits Chimiques S.A. (COFAZ), France's largest fertilizer producer, near yearend, thereby acquiring full ownership of the firm. The company continued to invest in new facilities, some of which came on-stream during 1987, and it closed outdated units at its plants in Western Europe. Ammonia capacity was fully utilized and urea capacity less so. Fertilizer prices did not rise sufficiently, after their sharp fall in 1986, to ensure adequate profitability for the Agricultural Group during 1987, but earnings were improved.

Graphite.—A/S Skaland Grafitverk was purchased by its West German competitor Graphitverk Kropfmuhl AG. A new 10,000-ton-per-year graphite-flake concentrator was under construction and was expected to be completed by early 1989. A 2-year exploration program, since the 1985 concentrator fire, had revealed reserves in quantity sufficient for 25 years of operation.

Mica.—Flake mica continued to be produced by Norfloat A/S at Glamsland near Lillesand as a byproduct of feldspar and quartz production through beneficiation of quarried pegmatite.

Quartz.—Technical startup problems prevented Minnor K/S, owned equally by Elkem and A/S Aker-Norcem, from putting its production plant for high-purity quartz on-stream as scheduled. Market introduction was delayed because the required high purity of product was not achieved despite intensive efforts.

Titania.—Problems in the operation of new equipment in the TiO_2-slag plant at Tyssedal prevented attainment of more than 20% production capacity and created a debt of $90 million after 1 year of operation. Failure to procure even short-term funding caused the Government-owned company's board to close the plant in late November. Financial support was still being sought at yearend for continuance of plant operation.

MINERAL FUELS

Coal.—Government-owned Store Norsk Spitsbergen Kulkompani A/S continued mining subbituminous coal with Government subsidies on Spitsbergen, the largest island in the Svalbard archipelago above the Arctic Circle, as it had for 70 years. Recent annual production had been 400,000 to 500,000 tons. Two longwall mines were operating in permafrost at Longyearbyen, and a third mine, a room-and-pillar operation, continued to be developed in Svea 40 miles southeast of Longvearbyen. Productivity at Longyearbyen had increased by 50% since 1982 to 7 tons per worker-shift. Reserves, mostly at Svea, were approximately 27 million tons. About 100,000 tons per year was exported to the Federal Republic of Germany for use in powerplants especially equipped to handle Spitsbergen coal. About 200,000 tons per year went to the state-owned coking plant in Mo i Rana, and the remainder was consumed in the Norwegian ferroalloy and cement industries.

Several years of exploration by a private Finnish-Norwegian consortium had revealed the existence of about 300 million tons of coal at Gipsdalen north of Longyearbyen. The consortium estimated that higher coal prices and an annual output of at least 1 million tons would be required in order to make a mining venture at Gipsdalen viable.

Natural Gas.—Approximately 43% of Norway's natural gas sales were from gasfields in Norway's portion of the Frigg area of the North Sea. The other sources were gas coproduct with oil from the Ekofisk area, 27%; the Heimdal Gasfield, 14%; byproduct gas from Norway's portion of the Statfjord Oilfield, 12%; and byproduct gas from the Valhall Oilfield and the new Ula Oilfield, most of the remainder. About 40% of gas production from the Statfjord Field continued to be reinjected to improve oil recovery. Natural gas sales, all exported, increased significantly in 1987 to meet export commitments, and output increased from Ekofisk, Heimdal, and Statfjord.

Proven reserves of natural gas in fields either producing or approved for development was sufficient for about 35 years at the 1987 gross output rate. An additional 45 years of resources was available in the North Sea and in the Haltenbanken and Troms-Finnmark areas of the more northerly Norwegian Sea.

The Frigg area consisted of the large Frigg Gasfield, which was jointly owned by Norway and the United Kingdom, and two smaller operating fields, North East Frigg and Odin. Gas from all three fields was processed and metered at the Frigg platform complex and then piped to St. Fergus in Scotland. East Frigg, another field within the area, scheduled to go on-stream in 1988, was also to feed into the Frigg Complex. Elf Aquitaine Norge A/S was the operator of all of the Frigg area fields. New reserve estimates made in 1987 indicated that gas in the Frigg area would be exhausted by yearend 1990, about 5 years sooner than previously expected, thereby reducing Norway's output and the United Kingdom's supply.

Development of the Den Norske State Oljeselskap A/S (Statoil) Tommelitin Gasfield began in 1987 and production was scheduled to begin in October 1988. The gas was to be piped to the Edda Field within the Ekofisk area. The intention was to inject this gas into the Ekofisk Field until 1991, after which it was to be piped to Karsto on the mainland for use in a to-be-constructed gas-fired electrical power station.

Engineering design of the platforms for the very large gasfields, Sleipner and Troll, began in 1987, mostly by Aker Engineering A/S. Troll was to have the largest platform in the North Sea. A/S Norske Shell was allowed by the Government to be Troll's operator until production was to begin in 1996, after which Statoil would become the operator. Statoil was already the operator of Sleipner, which was scheduled to begin production in 1993. After having decided to transport most of its Sleipner-Troll gas to Western Europe via Zeepipe through Belgium, Statoil was considering, as an alternative, use of the Netherlands North Sea gas-transmission system. Statoil anticipated future lower gas production by the Netherlands because of its depleting North Sea reserves.

One gasfield in the North Sea, 30/6 Gamma North, was declared to be commercial by its operator. The gas was to be used for injection into the Oseberg North Oilfield, which was under development. Estimated

gas reserves in Gamma North were 260 billion cubic feet.

Significant quantities of gas were found in the Hammerfest Basin in the Troms I sector of the Arctic offshore Tromsoflaket area north of Troms.

Petroleum.—Norwegian production of crude petroleum, all from the North Sea, increased for the sixth consecutive year. Statoil's large Statfjord Field, which was shared with the United Kingdom, continued to be the largest producer. The Norwegian portion of its output accounted for 60% of Norway's crude production in 1987. The Ekofisk area, operated by Phillips Petroleum Co. Norway A/S, produced 18% of Norway's crude from seven fields—Ekofisk, Eldfisk, Albuskjell, West Ekofisk, Cod, Edda, and Tor, in approximate order of size. The decks on five of the platforms in the central Ekofisk complex were raised simultaneously in August by 20 feet. This significant engineering feat was necessary because further subsidence of the seabed would have submerged critical operations. Production of crude from the field during 1987 decreased as predicted by the 1-month closedown. Future production in Ekofisk area fields was to be augmented by injection of water and nitrogen. About 9% of the natural gas coproduct was reinjected during 1987, less than during the previous year. The remainder of Norway's crude oil production was from the Ula Field, 8%; the Gullfaks Field, 7%; the Valhall Field, 6%; and the Murchison Field, 1%. Oil production from the new Ula and Gullfaks Fields accounted for most of the increased production in 1987. Gullfak's platform B, a drilling and water-injection unit, was placed in the field and was expected to be operating by early 1988, ahead of schedule. Platform C, the second Gullfaks production unit, was expected to be constructed by early 1988 on schedule with planned startup in 1989. Platform A began producing in late December 1986.

Income from the sale of Norwegian crude oil and natural gas had peaked in 1985 and equaled 19% of GNP. This dropped to 11% in 1986 and partially recovered to 12% ($10 billion) in 1987. Total 1987 investment in petroleum production and pipeline systems, excluding exploration, was $4 billion.

The Norwegian Government reduced Norway's production of crude by 8% below capacity, on a daily basis, during 1987. This step came in response to OPEC's call for production restraints as an aid in preventing world oil prices from dropping. This policy was not welcomed by the field operators, particularly at the partially United Kingdom-owned Statfjord Field. The Government modified its across-the-board-reduction position for the last quarter of 1987, allowing Gullfaks to assume Statfjord's 8% cut during that period.

Proven reserves of crude petroleum in fields either producing or approved for development decreased for the first time but were sufficient for 17 years of production at the 1987 output rate. Four fields provided 83% of this reserve. These were Oseberg, Statfjord, Gullfaks, and Ekofisk, in order of reserve volume. Oseberg, which was under development, was estimated to contain 25% of Norway's proven reserves. Other estimated crude oil resources in the North Sea were sufficient for an additional 9 years of production. The Smorre Field contained about 20% of this oil. Similar estimated resources in Haltenbanken in the Norwegian Sea were sufficient for an additional 5 years of production. The Heidrun Field contained nearly one-half of this and the Draugen Field nearly one-quarter.

Two North Sea oilfields received development approval from the Government in June 1987. The Veslefrikk Field to be operated by Statoil was scheduled to go on-stream in September 1989. A floating production platform was to be connected to a fixed wellhead platform. The oil was to be piped to the Oseberg platform and by-product gas was to be landed in Norway through the Statpipe system. The Gyda Field, to be operated by BP, was scheduled to go on-stream in September 1990 with water injection. The oil was to be piped to Ekofisk via the Ula Field. The coproduct gas was to be carried in a new pipeline directly to Ekofisk and used there. Total annual crude output from these two developing fields, which are about equal in size, was expected to equal 14% of 1987 production. Proven reserves were sufficient for about 1 decade of operation. Estimated development costs for the two fields totaled $2 billion.

Development of the southern portion of Statoil's large Oseberg Field continued. Construction of platforms A and B continued on schedule in conformity with the April 1989 startup date. Water injection was to be supplemented by injection of gas from the Troll Field beginning in 1992. Total oil production expectancy was 15 years. The crude was to be delivered to a new storage and loading platform at Sture

about 40 miles north of Bergen through a 68-mile pipeline constructed in 1987 as the first oil pipeline from the North Sea to mainland Norway. Total annual output was expected to equal 25% of 1987 crude oil production. Gas production was scheduled to begin after oil production was terminated. It was expected that most of the injected gas then would be recovered.

Development plans for five new oilfields were submitted for Government approval during the year by their operators. These were, in order of estimated oil reserves, the Snorre Field near Statfjord, operated by Saga Petroleum A/S; the Heidrun Field, with natural gas coproduct, in the Haltenbanken area of the Norwegian Sea north of Trondheim, operated by Norske Conoco A/S; the Draugen Field in the Haltenbanken area, operated by Norske Shell; the Oseberg North Field, operated by Norsk Hydro; and the Brage Field near Oseberg, operated by Norsk Hydro. Total estimated crude oil reserves of the five fields was 2.5 billion barrels and total expected annual production was 120 million barrels, equivalent to 35% of Norway's 1987 production. The operators projected that the fields could be variously on-stream between 1990 and 1992, assuming immediate approval, at an estimated total development cost of $11 billion. Industry sources forecast profitable operations at $15 to $18 per barrel through development of engineering efficiencies and economies. North Sea oil fluctuated between $17 and $20 during 1987. In view of the increase in field development applications, the Government prepared a report by yearend that called for limiting and prioritizing potential developments. A Parliamentary vote was expected during 1988.

Oilfield development in the Haltenbanken area was expected to be technologically difficult and costly and dependent on future markets for natural gas. Also, the area had no infrastructure. The fields were in deep water with a rugged sea floor. It was likely that the initial oil production would be transported by tankers.

Thirty-six exploratory wells were drilled in offshore Norway during 1987, the same as in 1986. Of these, 25 were initial exploratory (wildcats) and 11 were appraisal wells. Also, 17 were in the North Sea, 14 were off mid-Norway, including the Haltenbanken area, and 5 were in the Barents Sea. One U.S. operator, Mobil Development Norway A/S, made a significant gas-condensate discovery. Nine other wells tested positive. Of these, the most promising finds were oil near the Frigg and Heimdal Fields by Elf Aquitaine and oil near Statfjord and Gullfaks by Saga. All five wells drilled in the Barents Sea were dry except for a small gas find. This represented the first exploratory drilling in the Barents Sea. Some limited onland exploratory activity on Svalbard gave no significant findings.

In May, 13 exploratory licenses were granted—7 in the Barents Sea, 4 in Haltenbanken, 1 in the North Sea, and 1 in More South. Six U.S. oil companies participated as part owners of these licenses, and two, Conoco and Mobil, were operators.

The 12th exploratory round was announced in August, and the applications deadline was February 19, 1988. All of the blocks offered were in the North Sea near existing large producing or developing wells where prospects were good. Most were in the Ekofisk area near the United Kingdom North Sea border, the Statfjord area near both the Danish and the United Kingdom North Seas, and Sleipner. Awards were to be made during the summer of 1988.

Government-owned Statoil began an upgrading and a 63% expansion of its large Mongstad oil refinery and storage facility north of Bergen to 134,000 barrels per day. The construction, which included a new 40,000-barrel-per-day catalytic cracker, was about 60% completed by yearend and was scheduled for completion by yearend 1988. The minor partner in the venture, Norsk Hydro, sold its 30% share to Statoil in September for $91 million. It was apparent to Norway's Department of Energy by late summer that the cost of the expansion could be as high as $2 billion, about double that of the original estimate. Apparently, the complexity of the modification had been underestimated by Statoil. The Department appointed new directors to Statoil's board by yearend.

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[1]Physical scientist, Division of International Minerals.

[2]Where necessary, values were converted from Norwegian kroner (NKr) to U.S. dollars at the rate of NKr6.74=US$1.00, the average for 1987.

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